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SUPPLY CHAIN FLEXIBILITY AND SMEs: THE ROLE OF HUMAN RESOURCE FLEXIBILITY

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Abstract

SMEs are always at a disadvantage when dealing with market or supply chain disruptions. However, compared to large business systems, these enterprises are able to adapt more quickly to changes in the business environment. These reasons indicate that the flexibility of supply chains of SMEs is becoming a significant feature that allows companies to adapt their business process to the new situation. Flexibility can be a powerful tool for gaining a competitive advantage, reducing costs, and improving response to unforeseen situations. This article explores the relationships between human resource (HR) flexibility (especially employee skill flexibility) and business performance. Based on previous works, the simulation is used to assess the ability of the company to cope with the changing environment. Using the example of a real company, the effects of different personnel flexibility strategies on supply chain performance were observed.

Key words*: supply chain, human resource flexibility, SMEs.*

1. Introduction

The COVID-19 pandemic has disrupted global supply chains due to a sudden disruption in supply and demand. Given their relative lack of resources, finances, and "power", SMEs will always be at a disadvantage when it comes to dealing with significant market or supply chain disruptions. However, compared to large business systems, these enterprises are able to adapt more quickly to changes in the business environment (Utomo et al, 2021; Subramaniam et al, 2022;).

More recent works recognize the significant relationship between supply chain management, its flexibility and business performance (Dragic & Sorak 2016,

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Shakeel et al. 2017, Katou 2022). At the same time, the authors have expanded the purpose of supply chain management, so in addition to efficiency and effectiveness, the flexibility of supply chains has become imperative. Moreover, the flexibility of SME supply chains becomes a powerful tool for gaining competitive advantage, reducing costs and improving response to unforeseen situations. Therefore, traditional supply chain performance measurement systems, which usually only contain business performance measures, do not provide enough information.

The term Supply Chain Flexibility encompasses various aspects of flexibility that directly affect chain participants, management decisions and performance measures. Traditionally, the following dimensions of flexibility are most often discussed in the literature: Volume flexibility, Delivery flexibility, Mix flexibility, Sourcing flexibility and New product flexibility.

However, today's pronounced lack of human resources poses a new challenge for SMEs. Namely, even when SMEs are able to financially provide capacity expansion, in order to satisfy customer requirements, the lack and fluctuation of labour force have an extremely negative impact on the achieved business performance.

Stokes and Harris (2012), human resource flexibility define as the extent to which the firm's human resources possess skills and behaviour repertoires which offer the organization a chance to develop strategic alternatives within its competitive environment. Sabuhari and Irawanto (2020) study introduced a conceptual framework to enhance the understanding of the versatility of human resources flexibility. They suggested that the performance of workers can be affected by various factors such as the versatility of employee abilities, flexibility of employee actions, flexibility of human resource practice and flexible work arrangements. Several authors point to the complexity of measuring flexibility by recognizing its sub-dimensions such as, employee skill flexibility, behaviour flexibility and human resource practice flexibility (Ngo & Loi, 2008; Barinua & Fubara, 2022). Finaly, Fadi and Abed (2022) research has shown that there is a significant impact of human resource flexibility on the success of supply chain management.

In this context, the purpose of this paper is to develop a comprehensive simulation model to examine the interrelationships between human resource flexibility, supply chain flexibility and business performance. The work methodology includes improvement of the existing simulation model, planning and execution of simulation experiments, and analysis of results, and drawing conclusions.

2. Materials and Methods

Experimenting with real SMEs is not always possible. However, experimentation on a simulation model can provide information about the behaviour of a real system. In this paper, we propose a modular system dynamics model of integrated business processes. This model has been described in previous works (Sorak & Dragić, 2013; Dragić & Sorak, 2016; Dragić, 2021). It shows the

elements and equations of the model, which are equivalent to the behaviour of the real system. The described model consists of the following four modules: M1 – Forecasting and initiation of customer demands, M2 – Sales and delivery, M3 – Preparation and execution of work processes, and M4 – Inventory management of raw materials.

Figure 1 shows the flow diagram for the module M3- Preparation and execution of work production processes. The module follows the course from the opening of the task to delivery of finished goods. Production process is organized as a process focused, and each batch goes through one stage of the production process before moving onto next stage.

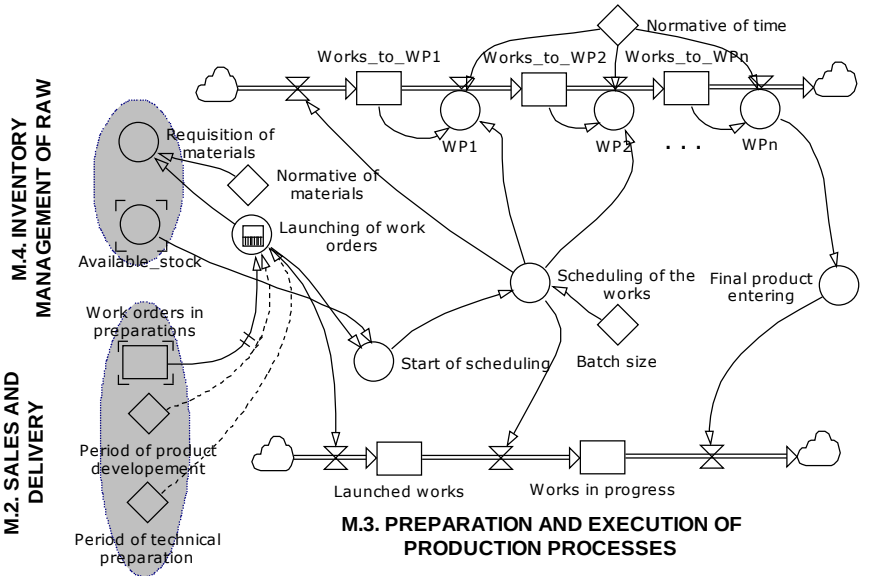

Figure 1: Flow diagram for the module M3- Preparation and execution of work production processes

The applied model recognizes the specificities of SMEs, such as a large range of products, the use of a wide variety of materials, production in small batches and requests for reduction of lead time. Through a series of experiments, the behaviour of the system can be simulated under different conditions, including different inventory management policies, customer demand management practices, scheduling and availability of resources (equipment and human resources). The effects of simulated actions are monitored by measuring performance.

An adequate system for measuring the performance of an SME's supply chain is crucial for successful supply chain management. This system can be defined as a set of elements used to quantify the effectiveness and efficiency of supply chain management. Performance measures of SMEs companies' supply chains generally use a combination of cost measures and measures of response to customer demands. In addition to quantitative measures, more and more authors recognize other suitable performance measures, which are not adequately used in supply

chain research. Examples of such measures include user satisfaction, information flow, supplier performance, as well as risk management (Shepherd & Gunter, 2006; Anderson et al., 2017; Dragić, 2021). The chosen set of supply chain performance measures should be directly related to the strategy of supply chain management. This paper will use the classification framework described in the author's previous works (Sorak & Dragić, 2013; Dragić & Sorak, 2016; Dragić, 2021;), expanded for human resource flexibility measures (Table 1).

Table 1: Proposed Framework for defining Supply Chain Performance Measures

Supply chain structure	**Supply chain management**	**Performance**	**Performance measures**
Participants Resources Processes Material flows Information flows	Who manages the supply chain? What management strategies are used?	Resource utilization	• Funds engaged • Productivity • Capacity utilization • Inventory turnover...
		Desired output	• Value of completed orders • Fulfilled orders on time • User satisfaction • Costs of non-compliance...
		Flexibility	• Flexibility of delivery times • Flexibility of delivery volume • Flexibility of the product range • Procurement flexibility • Human resource flexibility...

2. Results

The experiment was conducted on the sample of a small company in the field of metal production. There are about 30 workers of different professions. The production program of the company consists mainly of products made of sheet metal. For research purposes, the product range, and number of raw materials were reduced. So, we have 6 kinds of products (with two order fulfilment options: Make-to-Order and Make-to-Stock), 36 kinds of raw material, 10 kinds of equipment recourses (28 units), and 10 phases of production. In the first step, the period of one working hour (1 WH) is adopted as the basic time unit (step of the simulation). The period of the simulation execution corresponds to the fourth quarter of the fiscal year 2024. If we assume that the enterprise operates five days a week, in this period there are 65 working days (with 8 WH), the total time will be 520WH. Part of the initial data is shown in tables 2 and 3.

Table 2: Reduced product range with the demand model parameters

PRODUCT:		*WH* – the working hour	Price (€)	Order fulfilment options	Safety stock	Batch size (Units)	Demand lead-time (WH)	Demands units/WH) +/- deviation	Order lead-time +/- deviation
	ID	**Name**							
1	400000	Surface-mounted lamp	15	MTS	50	150	0	$4^{+/-2}$	$8^{+/-4}$
2	410000	Archive cabinet	65	MTO	0	0	160	$20^{+/-8}$	$2^{+/-1}$
3	420000	El. distribution cabinet	200	MTO	-	-	120	$2^{+/-1}$	$14^{+/-6}$
4	440000	Rack 400x1000x2000	30	MTS	100	150	0	$20^{+/-10}$	$4^{+/-2}$
5	470000	Net stand 10x1800x500	90	MTO	-	-	160	$4^{+/-2}$	$24^{+/-8}$
6	490000	Distribution board	6	MTO	-	-	0	$40^{+/-10}$	$16^{+/-6}$

Table 3: Capacity required per product unit (reduced list)

Required equipment	HMZ	LAS	EUR	MHP	APP	CO2	BRU	LAK	MON	MONE	Total production time (min)
Preparation time	15min	15min	20min	20min	15min	15min	10min	30min	20min	30min	
Product	*Production time (min)*										
400000	0.00	2.80	2.83	2.00	3.40	3.00	2.00	3.00	6.00	4.00	29.03
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490000	1.60	0.00	1.50	0.00	1.60	3.00	0.00	0.25	0.00	0.00	7.95

Performing simulations for a certain period of time and under certain conditions (adjusting process parameters) the future behaviour of the process can be predicted and shown through the expected performance of the process (Table 4.). These performances are compared to planned performances, and if necessary, corrective actions are initiated (by changing the parameters of the process). The effectiveness of corrective actions can be predicted by performing simulations under new conditions. The experiment needs to show how such changes affect other measures of business performance. In these experiments, the focus will be on the actions resulting from the human resources flexibility.

The first experiment was conducted using the model parameters adopted from the real data of the simulated system (Table 2 and 3). The behaviour of the simulated system is represented by monitoring performance measures (Table 4).

Table 4: Measure performance definition, and overview of the basic experiment results

Goal	Name	Definitions	Value
↓	The average level of finished goods	The average value of finished goods supply over time	4673.20€
↑	Fulfilment of orders from existing stocks	Percentage of the amount of goods that can be met with existing supplies	46.30%
↑	Delivery timeliness	The percentage of orders that are met before or as scheduled / promised delivery date.	67.87%

Goal	Name	Definitions	Value
↑	The value of executed orders	The total value of orders received in the relevant period	347800.00€
↑	Equipment capacity utilization	The relationship between the required and available capacity of equipment	73.37%
↑	HR Capacity utilization	The relationship between the required and available capacity of HR	73.37%
↓	The average level of work in progress	The average value of work in progress	75670€
↓	Manufacturing Cycle Time	Total time taken to convert raw materials into finished goods.	689h
↓	Delivery time flexibility	The percentage of surplus time on the realization of customer requests	11.20%

Customer satisfaction is the key to continuing success of the enterprise. The results of the experiment show a low level of fulfilment of orders from existing stocks (44.99%), and a low percentage of orders fulfilled on time (67.87%). So below, we'll predict the effects of increasing the flexibility of human resources. Suggested solutions are given in Table 5. Simulation experiments should show how such changes affect performance measures. A comparative overview of the experiment results is shown in the table 6.

Table 5: The solution plan

S1	*Increased available equipment capacity and HR Skill Flexibility* We shall increase the number of equipment which have the highest capacity utilization like as APP, CO2, MONT, and EUR. At the same time, the number of workers remains the same, but the workers have additional skills for work.
S2	*Human resource practice flexibility* Flexible working hours are being introduced, i.e. the possibility to, if necessary, increase working hours by 20% for overloaded workplaces.

3. Discussion

The increase in capacity, with human skills flexibility, had a positive effect on the improvement of almost all output performances. Thus, the fulfilment of orders from existing stocks increased from 46.30% to 83.92%, the delivery timeliness increased from 67.87% to 100%, the value of orders realized in the simulated period increased by 25%, the duration of the production cycle decreased by 81 term units, and the average level of unfinished production decreased by about 40%. Due to the larger number of equipment, capacity utilization decreased from 73.37% to 67.73%, while at the same time the utilization of human resources increased significantly. (Table 6).

The second solution of the experiment, increasing working time, also showed significant positive effects on delivery performance. Although the improvements are not as great as in the first case, this option does not require additional financial investments in equipment.

Table 6: A comparative overview of the experiment results

Goal	Name	Basic Exp.	S1	S2
↓	The average level of finished goods	2673€	4825€	2448€
↑	Fulfilment of orders from existing stocks	46.30%	83.92%	64.62%
↑	Delivery timeliness	67.87%	100.00%	84.26%
↑	The value of executed orders	347800€	433560€	350432€
↑	Equipment capacity utilization	73.37%	67.73%	76,24%
↑	HR Capacity utilization	73.37%	88.56%	76,24%
↓	The average level of work in progress	75670€	48247€	74418€
↓	Manufacturing Cycle Time	689h	606h	694h
↓	Delivery time flexibility	11.20%	68.39%	24.14%

4. Conclusions

The results show that human resources flexibility can be a significant source for improving the SMEs performance. The presented model can be used to find solutions for a wide range of problems related to human resource management, starting from determining the type of human resources competence (long-term decision), and to considering the effects of flexible working hours in the production work schedule (current decision).

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